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ABSTRACT

The productivity of the U.S. work force is a primary determinant of the standard of living of the U.S. population. Worker productivity is affected by many factors, including the education and skills of the work force. This handbook highlights several measures of productivity and education, and addresses the link between these two sets of measures. The handbook provides data on the following subjects: the trends in worker productivity and the contribution of education; the economic consequences of education for individuals; educational achievement; adult literacy; and the training of labor force participants. The data suggest that American workers are more productive, on average, than workers in any other country; however, worker productivity in several industrialized countries is gradually catching up to that in the U.S. The education of the work force is growing more rapidly in other countries than in the U.S. Although the U.S. leads almost every other industrialized country in college attainment, and the academic achievement of American students has been improving in recent years, U.S. students still tend to lag behind students in other countries with respect to some measures of achievement, particularly in mathematics and science. Finally, when compared with other countries that have tested literacy, the U.S. has a higher concentration of adults who score at the lowest literacy levels. Sixteen figures are included. (LMI)

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FINDINGS FROM

EDUCATION AND THE ECONOMY: AN INDICATORS REPORT

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EDUCATION AND THE ECONOMY: AN INDICATORS REPORT

Paul T. Decker
Mathematica Policy Research, Inc.

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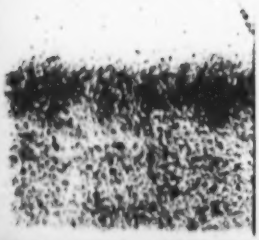


FINDINGS FROM

EDUCATION AND THE ECONOMY: AN INDICATORS REPORT

The productivity of the U.S. work force is a primary determinant of the standard of living of the U.S. population. Worker productivity is typically measured as output per worker or per hour worked. It is affected by many factors, including the education and skills of the work force. Education and skills are important because they expand a worker's capacity to perform tasks or to use productive technologies. In addition, better educated workers can adapt more easily to new tasks or to changes in old tasks. Education may also prepare workers to work more effectively in teams because it enhances their ability to communicate with and understand their co-workers.

Much of the recent concern about the productivity of U.S. workers has been prompted by uncertainty about the ability of domestic firms and workers to compete in an increasingly international marketplace. As growth in U.S. productivity has slowed over the past two decades and other countries achieve productivity levels similar to those in the United States, concern about the competitiveness of U.S. firms and workers has increased. Some attribute the loss of the nation's productivity advantage to what they claim is the limited ability of the U.S. educational system to provide students with the skills necessary to succeed in today's labor market. However, factors other than education also affect productivity, and these must be considered when comparing productivity trends across countries.

Variation in the quality and quantity of education across countries is only one factor contributing to differences in worker productivity; capital investment, technical innovation, foreign trade, and government regulation can also affect productivity. Nevertheless, education

remains an important contributor to productivity growth and has a major influence on the standard of living. This essay highlights several measures of productivity and education, and addresses the link between these two sets of measures. A better understanding of the relationship between worker productivity and the condition of education is essential to understand how investment in education contributes to the U.S. economy.

Trends in Worker Productivity and the Contribution of Education

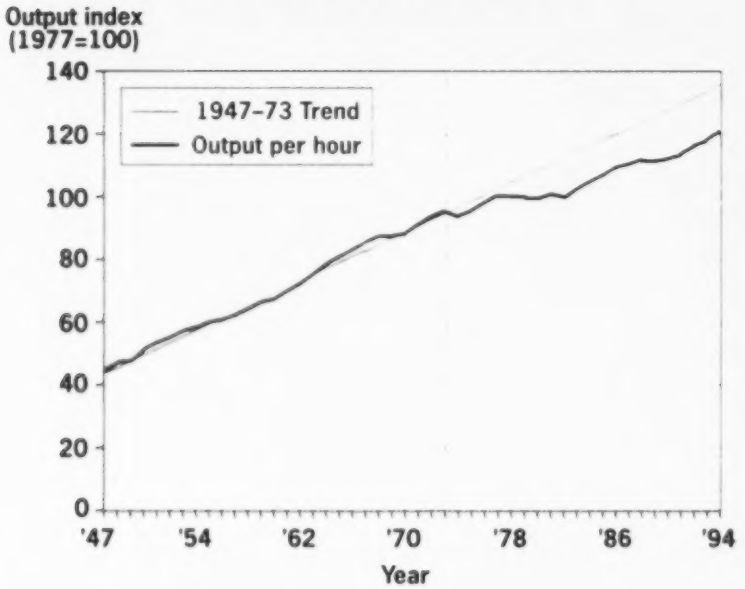
■ ***Worker productivity in the United States has increased almost continuously since the end of World War II, but growth has slowed since 1973.***

Worker productivity in the United States has grown almost continuously since the end of World War II, rising to a level in 1994 that is approximately three times that of 1947 (figure A). Post-war growth in productivity was slower after 1973 than it was before 1973. From 1947 through 1973, output per hour increased by nearly 3 percent per year, compared to slightly more than 1 percent per year from 1973 through 1994. It is unclear whether the slowdown in productivity growth since 1973 merely reflects fluctuation around the long-term growth rate, which is equal to about 2 percent, or whether it signals slower long-term growth.

■ ***Since World War II, worker productivity has grown more slowly in the United States than in other industrialized countries.***

For several decades, productivity in other industrialized countries has been gradually catching up to that in the United States (figure B). However, the United States remained the leader as of 1990, with a gross domestic product (GDP) per worker that was slightly higher than that in Canada, and about 25 percent higher than that in Italy, the country with the third highest GDP per worker.

Figure A
Index of real output per hour of all persons, business sector: 1947–94



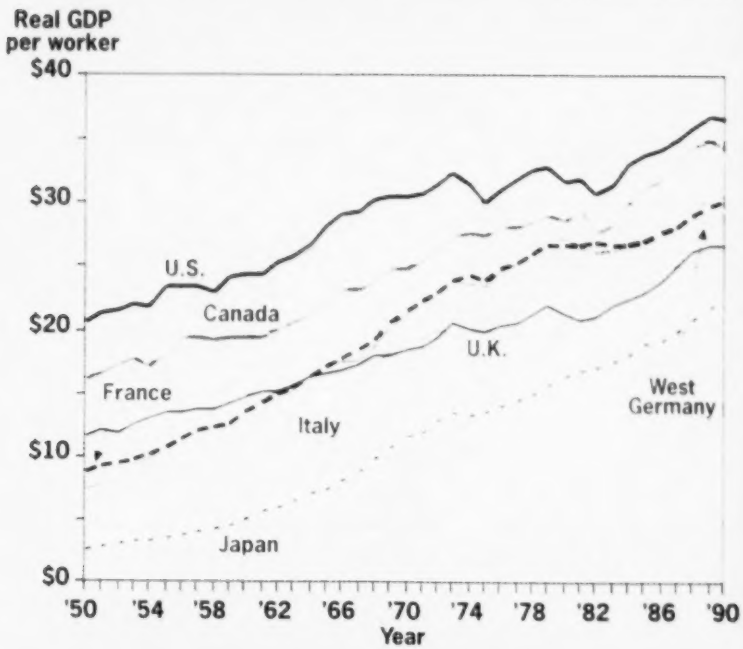
NOTE: Figures for years after 1988 were originally based on 1982=100. They were multiplied by a factor of 1.013 for use in the 1977=100 index. Hours of all persons include hours of employees, proprietors, and unpaid family workers. Output is the constant-dollar market value of final goods and services produced. For the business sector, the index relates to gross domestic product (GDP) less general government, output of nonprofit institutions, output of paid employees of private households, and rental value of owner-occupied dwellings. Business output was about 78 percent of GDP in 1992.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics*, Washington, DC: U.S. Government Printing Office, 1989; *Monthly Labor Review* 18 (8) (August 1995): 175.

According to one theory of productivity growth, referred to as the *convergence hypothesis,*[1] it is to be expected that productivity in lagging countries will converge on that of the United States because these countries can exploit technologies transferred from the United States, thereby closing the gap in worker productivity. This "catching-up" process suggests that the United States is inevitably at risk of losing its lead in worker productivity as long as other countries have the capabilities, including an adequately educated work force, to exploit new productive technologies.

The ability of the United States to have maintained a substantial lead in productivity for nearly a century is at least partly attributable to the two world wars, which destroyed the productive capacity of other countries while spurring technological innovation in U.S. manufacturing. However, the huge productivity advantage of the United States has dissipated under the more normal post-war economic conditions, which have allowed other countries to rebuild their productive capacities and expand their technological capabilities. It now appears that the other industrialized countries may eventually share the lead in productivity with the United States.

Figure B
Real GDP per worker in G–7 nations: 1950–90
(in thousands of dollars based on 1985 international prices)



SOURCE: Penn World Table (Mark 5.6), distributed by the National Bureau of Economic Research. For a description, see Robert Summers and Alan Heston, "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950–1988," *Quarterly Journal of Economics* (May 1991): 327–368.

But insofar as the "catching-up" process involves the transfer of technology from the leader country to the lagging countries, the process should eventually slow down as the lagging countries exhaust their opportunities to exploit new technologies from the leader. Eventually, the countries sharing the lead in productivity would presumably be in a position to exploit technological advances from each other.

- ***Growth in education has historically been an important source of growth in worker productivity.***

Increases in educational attainment were responsible for an estimated 11 to 20 percent of growth in worker productivity in the United States in recent decades.[2] Growth in factors other than education have also contributed to growth in worker productivity. For example, increases in capital accounted for an estimated 40 percent of growth in worker productivity in the United States from 1948 to 1990.[3] In addition to capital, such factors as technical innovation, foreign trade, and government regulation can also affect productivity.

The historical contributions of these factors affecting productivity are not necessarily indicative of the relative returns to potential investments in the factors. They simply reflect the linking of the relative growth rates of each factor over the past several years to the productivity growth rate. The growth accounting methods used to determine these sources of productivity growth cannot be used to identify future preferred input investments.

Education appears to play an important role in worker productivity in all industrialized countries. The industrialized countries with the highest productivity levels tend to have highly educated work forces, and the convergence in productivity among these countries generally parallels that in educational attainment.

THE ECONOMIC CONSEQUENCES OF EDUCATION FOR INDIVIDUALS

Ultimately, growth in a nation's productivity results from growth in the productivity of individual workers. The best available measure of a worker's productivity is that worker's wages, as employers generally pay wages equal to the marginal productivity of their workers. The impact of education on the productivity of workers can be determined by estimating the impact of education on wages.

Education may also improve workers' employment stability, enabling more educated workers to maintain their jobs or to quickly find new jobs in the face of changing economic conditions. Therefore, the association between education and unemployment can be a further indication of the effect of education on the productivity of workers.

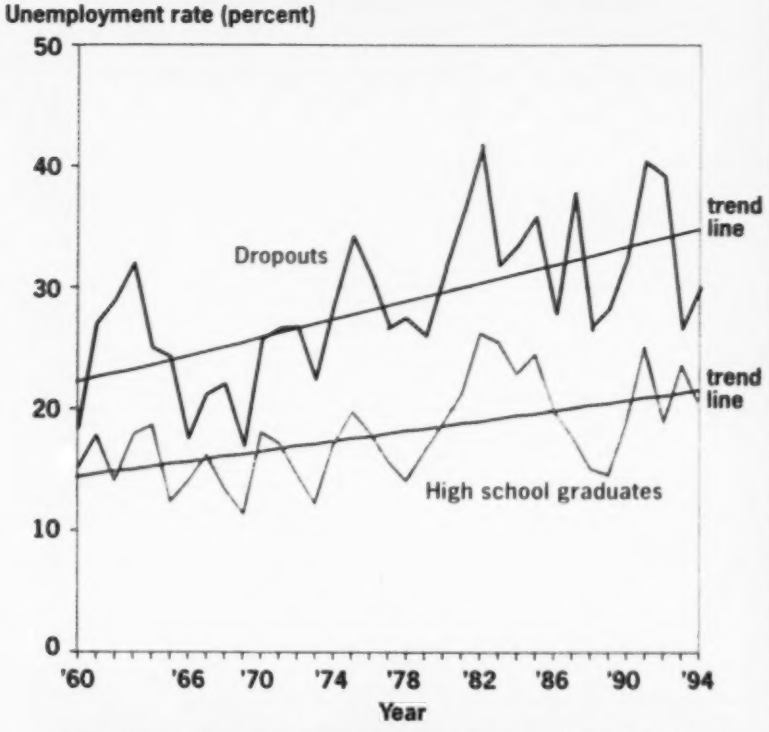
Educational Attainment

- ***Workers with higher educational attainment are unemployed less and earn more than workers with lower educational attainment.***

Over the past 30 years, a substantial proportion of high school graduates and dropouts were unemployed shortly after leaving high school, with dropouts generally facing a higher unemployment rate than graduates (figure C). In 1994, 30 percent of recent dropouts were unemployed, compared to 20 percent of recent graduates not enrolled in college. The unemployment rates for both groups have increased since 1960.

Median earnings are positively associated with educational attainment (figure D). Among males ages 25–34 years in 1993, median

Figure C
Unemployment rate of recent high school graduates and dropouts not enrolled in college: 1960–94

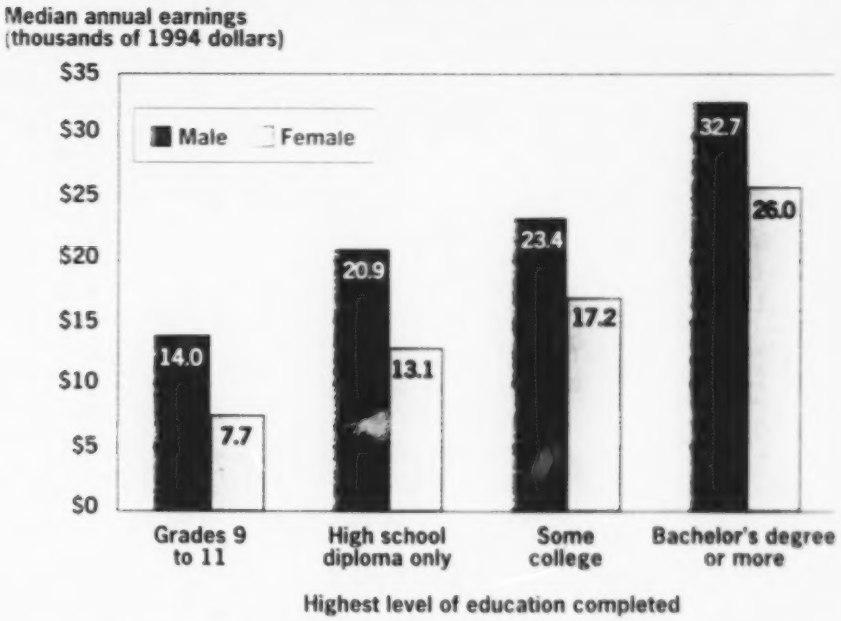


NOTE: Recent high school graduates include individuals ages 16–24 years who graduated during the survey year and were not enrolled in college. Recent high school dropouts include individuals ages 16–24 years who did not graduate and who were in school 12 months earlier, but who were not enrolled in the survey month.

SOURCE: U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1995*, and special tabulations; U.S. Department of Commerce, Bureau of the Census, October Current Population Surveys.

earnings of those with a college degree were equal to about $33,000 per year, which was more than 50 percent greater than the median earnings of high school graduates and more than twice those of high school dropouts. The relationship between education and earnings for females is similar, although within each educational category, earnings are lower for females than for males.

Figure D
Earnings for all wage and salary earners ages 25–34 years, by sex and educational attainment: 1993



SOURCE: U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1995*; U.S. Department of Commerce, Bureau of the Census, March Current Population Survey, 1994.

■ *Educational attainment in the United States has increased over the past 20 years.*

The proportion of 18- to 24-year-olds who have completed high school has increased slowly, rising from approximately 83 percent in 1972 to about 86 percent in 1994 (figure E). An increasing number of students who have completed high school also move on to college. Among recent high school graduates, the college enrollment rate increased from 49 percent in 1972 to 62 percent in 1994.

However, many students who enroll in college do not complete four years there. The completion rate of 27 percent in 1994 was only slightly higher than the rate of 20 years before.

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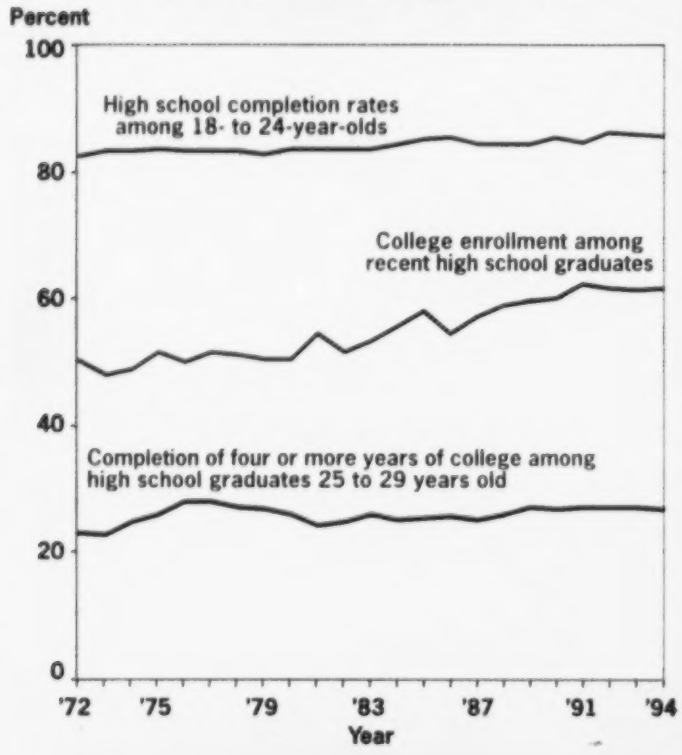
Figure E
High school completion, college enrollment, and college completion rates: 1972–94



SOURCE: U.S. Department of Education, National Center for Education Statistics, *Dropout Rates in the United States: 1994*; U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1995* and *The Condition of Education, 1996*; U.S. Department of Commerce, Bureau of the Census, October and March Current Population Surveys.

■ ***Although the rate of college completion in the United States still far exceeds that in most other countries, educational attainment generally is increasing more slowly in the United States than in other industrialized countries.***

In each of the G–7 countries, the rate of secondary school completion is higher among 25- to 34-year-olds than among 25- to 64-year-olds, indicating that the rate of secondary school completion

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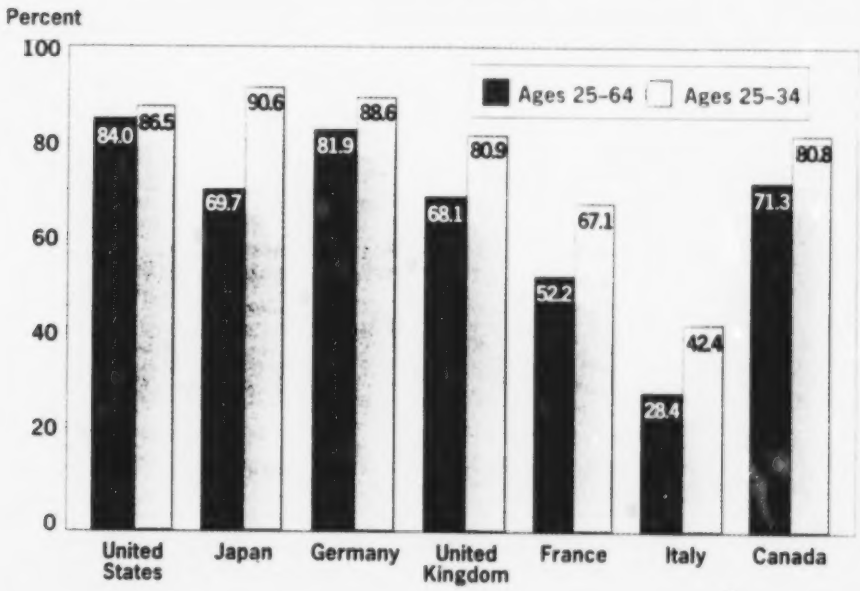
Figure F
Secondary school completion, by age: 1992



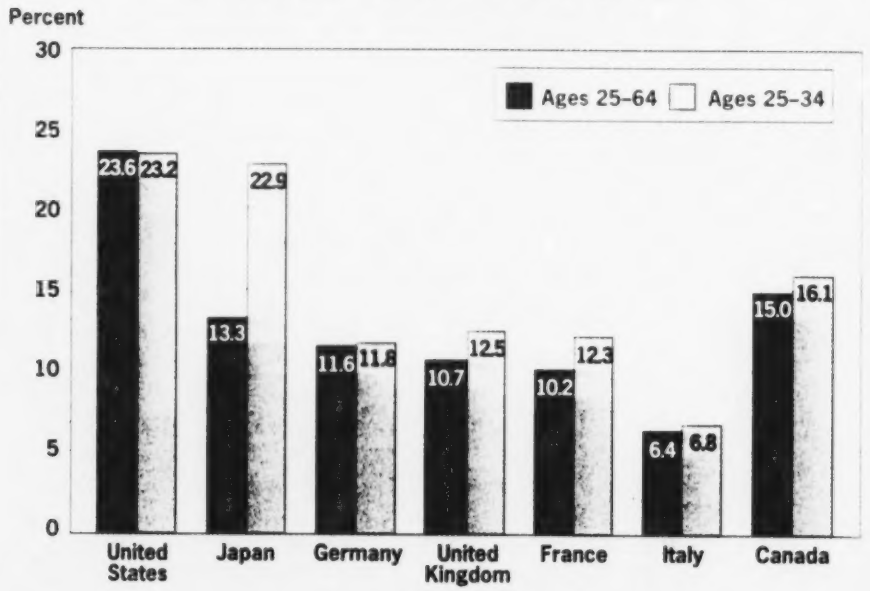
NOTE: In the United States, completing secondary school is defined as graduating from high school or earning a GED.

SOURCE: U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1995*; Organization for Economic Cooperation and Development, Indicators of Education's Systems, *Digest of International Education Statistics*, forthcoming.

is increasing in these countries (figure F). Moreover, the gap between the completion rates of younger and older workers is larger in other G-7 countries than in the United States, suggesting that secondary school attainment is increasing at a faster rate in the other countries. The high school completion rates for young adults in Japan and Germany are now comparable to those of young adults in the United States, while the rates for young adults in Canada and the United Kingdom are approaching those of their counterparts in the United States.

Most G–7 countries still lag well behind the United States in higher education attainment (figure G). The proportion of the population ages 25–64 years who have completed a college education is by far the highest in the United States. Although the U.S. lead is smaller for adults ages 25–34 years, only Japan has a rate of higher education attainment among young adults comparable to that in the United States. The rate of college completion among young American adults has risen slightly during the past 20 years, while the rate for young adults in Japan has risen dramatically; thus, Japan has nearly caught

Figure G
Completion of higher education, by age: 1992



NOTE: In the United States, completing higher education is defined as earning a bachelor's degree.

SOURCE: U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1995*; Organization for Economic Cooperation and Development, Indicators of Education's Systems, *Digest of International Education Statistics*, forthcoming.

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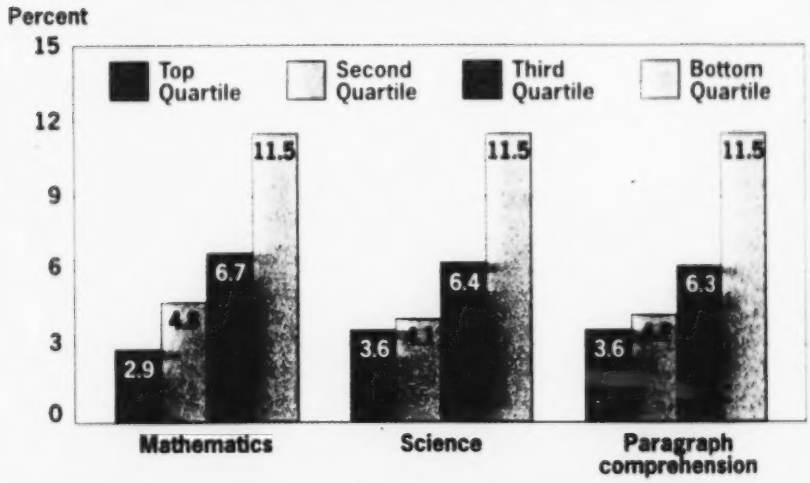
up to the United States. The rate of higher education attainment in most other G-7 countries has increased more slowly than that in Japan, as indicated by the smaller attainment gaps between younger and older adults in those countries.

Educational Achievement

- ***Workers who have a record of high academic achievement, as measured by achievement test scores, are unemployed less and earn more than workers with lower scores.***

Figure H
Unemployment rate of civilian workers age 28 years, by age-adjusted ASVAB score quartile: 1985–93

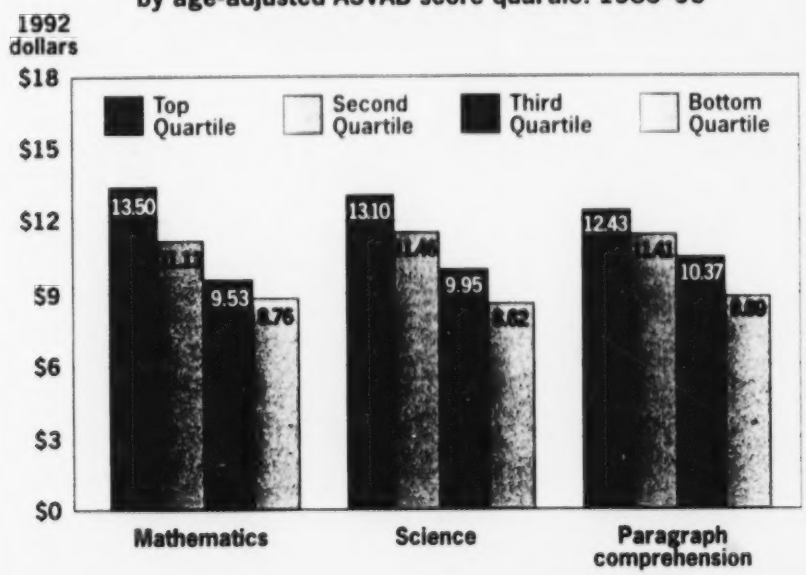


NOTE: ASVAB is the Armed Services Vocational Aptitude Battery. To control for differences in age at testing, individuals were assigned to age-specific performance quartiles for each subject area based on their age at testing. Respondents who were out of the labor force were excluded from the sample.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, National Longitudinal Survey of Youth, 1985–93.

Workers who are 28 years old and who have previously scored in the top quartile on the Armed Services Vocational Aptitude Battery (ASVAB) mathematics, science, or paragraph comprehension tests have a lower unemployment rate than other workers (figure H). For example, 2.9 percent of workers in the top quartile of the mathematics test are unemployed, compared to 7.5 percent of workers in the other three quartiles combined. Workers in the top quartile on the tests in each subject also earn more, on average, than other workers (figure I). For example, workers in the top quartile on the mathematics test earn an average of $13.50 per hour, compared to an average of $9.84 per hour for workers in the other three quartiles combined.

Figure I
Mean hourly rate of pay for civilian workers age 28 years, by age-adjusted ASVAB score quartile: 1985–93



NOTE: ASVAB is the Armed Services Vocational Aptitude Battery. Respondents reporting hourly pay of less than $1.00 or greater than $100.00 (1992 dollars) at any given age were excluded from the sample for that age. To control for differences in age at testing, individuals were assigned to age-specific performance quartiles for each subject based on their age at testing.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, National Longitudinal Survey of Youth, 1985–93.

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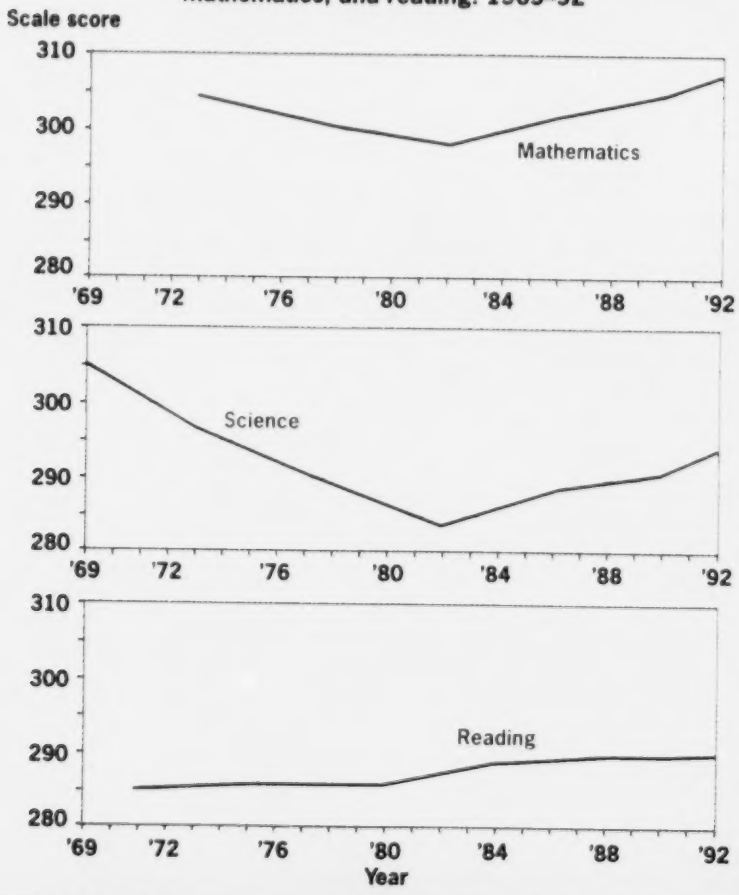
■ ***Test scores of U.S. students generally increased in the 1980s and 1990s, offsetting declines that occurred during the 1970s.***

Among 17-year-old students, National Assessment of Educational Progress (NAEP) test scores increased from 1982 through 1992 (figure J). Increases in mathematics and science scores reversed a trend of declining scores that existed throughout the 1970s. By 1992, the scores in these subjects had recovered to the 1973 levels. NAEP reading scores of 17-year-old students have increased slowly and steadily since the early 1970s.

Figure J
Trends in average U.S. achievement of 17-year-olds in science, mathematics, and reading: 1969–92



SOURCE: U.S. Department of Education, National Center for Education Statistics, *The National Assessment of Educational Progress: 1992 Trends in Academic Progress*, 1994.

■ ***U.S. students trail students from many other countries in mathematics and science achievement, but U.S. students tend to lead in reading achievement.***

Most of the countries included in a 1991 international study of mathematics and science achievement outperformed the United States in the mathematics achievement of both 9-year-old and 13-year-old students (table A). With respect to science achievement, 9-year-old U.S. students performed as well as those in most other countries, but 13-year-old U.S. students scored below their counterparts in half of the other countries. In a separate international study of reading achievement, the United States led 20 of 22 countries in reading scores for 9-year-olds and was equivalent to or led 21 of 22 countries for 14-year-olds.

Table A
International distribution of academic achievement relative to the United States: 1991–92

Subject and age	Number of countries performing: Significantly higher than the U.S.	Not significantly different from the U.S.	Significantly lower than the U.S.	Number of countries in the study
MATHEMATICS				
9-year-olds	7	2	0	10
13-year-olds	12	1	1	15
SCIENCE				
9-year-olds	0	7	2	10
13-year-olds	7	6	1	15
READING				
9-year-olds	1	1	20	23
14-year-olds	1	14	7	23

SOURCE: U.S. Department of Education, National Center for Education Statistics, *The Condition of Education, 1993*; Warwick B. Elley, *How in the World Do Students Read?*, International Association for the Evaluation of Educational Achievement, Study of Reading Literacy, 1992; and Educational Testing Service, International Assessment of Educational Progress, 1992.

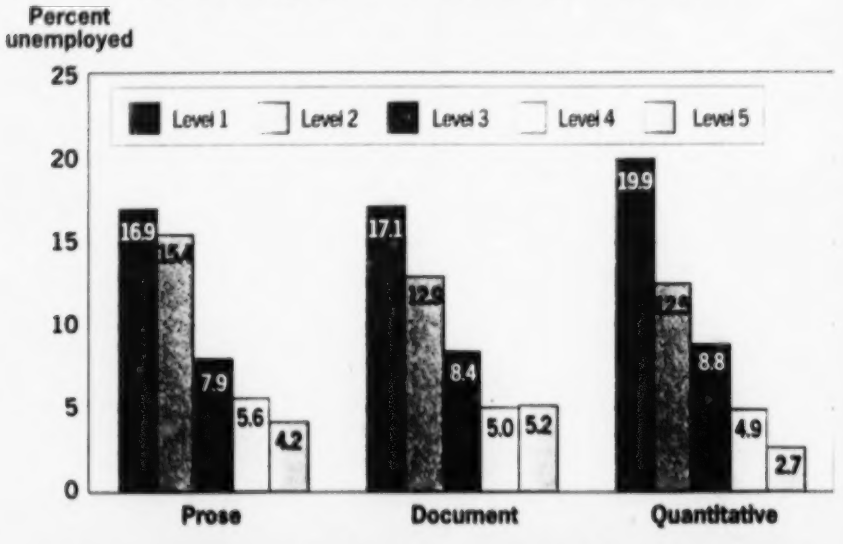
Adult Literacy

A 1992 study tested the performance of U.S. adults on three scales of literacy—prose, document, and quantitative—and categorized adults into five literacy levels according to their test scores, with level 1 being the lowest literacy level and level 5 being the highest.

- ***Workers with higher literacy scores are unemployed less and earn more than workers with lower literacy scores.***

Unemployment rates are especially high for workers in the two lowest levels of literacy—levels 1 and 2—on each of the three literacy scales (figure K). For these workers, the unemployment rate ranges from 12 percent for workers with level 2 quantitative literacy to nearly 20 percent for those with level 1. Unemployment rates for individuals in the two highest literacy levels—levels 4 and 5—are less than 6 percent.

Figure K
Unemployment of adult labor force participants, by proficiency level on three literacy scales: 1992



SOURCE: Andrew Sum, *Literacy and the Labor Force: Results of the National Adult Literacy Survey*, forthcoming; U.S. Department of Education, National Center for Education Statistics, National Adult Literacy Survey, 1992.

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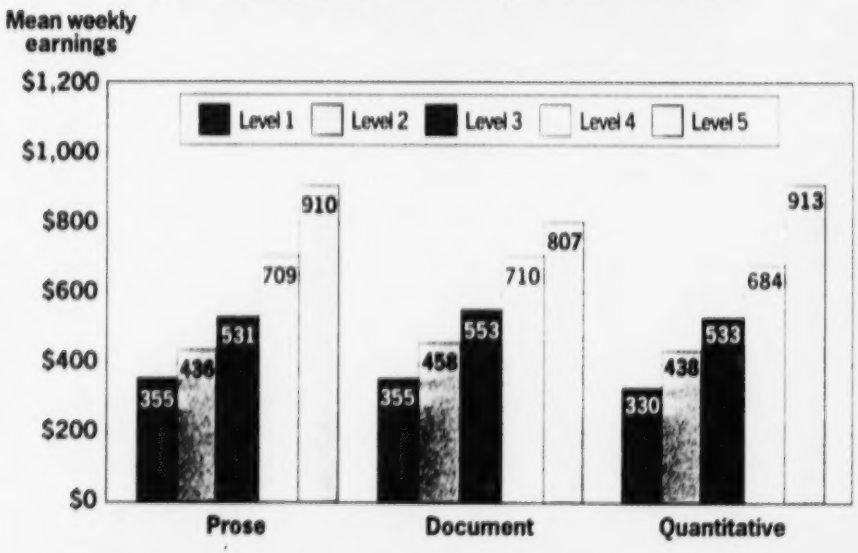
Workers with high literacy scores earn more than other workers, on average (figure L). On the prose scale, for example, full-time workers in level 3 earn a mean weekly wage that is 50 percent higher than that of their counterparts in level 1. Those in level 5 earn a weekly wage that is 71 percent higher than the wage of those in level 3.

Figure L
Mean weekly earnings of full-time workers, by proficiency level on three literacy scales: 1992



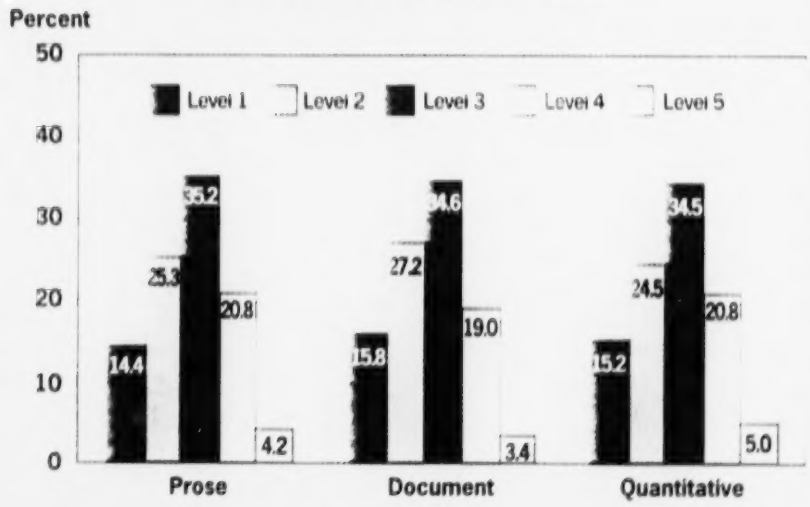
SOURCE: Andrew Sum, *Literacy and the Labor Force: Results of the National Adult Literacy Survey*, forthcoming; U.S. Department of Education, National Center for Education Statistics, National Adult Literacy Survey, 1992.

■ ***The literacy proficiency of a substantial proportion of the U.S. labor force is limited, and only a small proportion of workers perform at a high literacy level.***

Forty percent or more of the adult labor force perform at the two lowest levels on each of the literacy scales, suggesting that many workers lack the skills needed to interpret, integrate, and compare or contrast information using written materials common to the home or workplace (figure M). These workers appear to be unable

to perform the types of tasks typical of certain occupations that demand high skills, such as professional, managerial, technical, high-level sales, skilled clerical, or craft and precision production occupations. Five percent or fewer of U.S. labor force participants score in the highest proficiency levels, demonstrating an ability to perform well on a wide array of literacy tasks.

Figure M
Percentage of labor force in each proficiency level on the three literacy scales: 1992

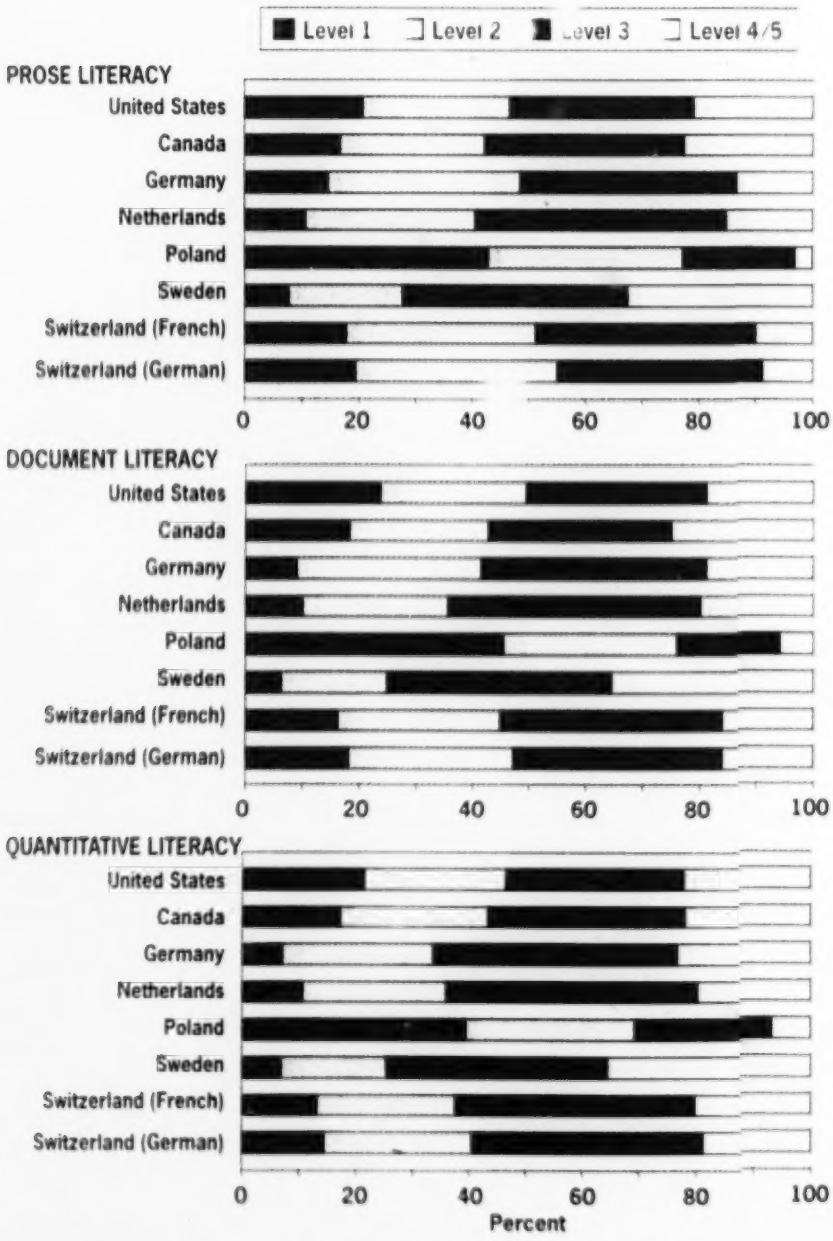


SOURCE: Andrew Sum, *Literacy and the Labor Force: Results of the National Adult Literacy Survey*, forthcoming; U.S. Department of Education, National Center for Education Statistics, National Adult Literacy Survey, 1992.

■ ***Literacy of the U.S. adult population is, on average, roughly similar to that of populations in other industrialized countries, but the United States has a greater proportion of adults at the lowest literacy levels.***

On average, the proportion of the U.S. population in the highest literacy levels is similar to that in the other countries included in an international study of adult literacy (figure N). However, the United States has a higher concentration of adults in the lowest literacy level than nearly all of the other countries. More than 20 percent of the U.S. sample

Figure N
Estimated percentage of the population in each proficiency level on three adult literacy scales, by selected countries: 1994



SOURCE: Organization for Economic Cooperation and Development and Statistics Canada, *Literacy, Economy and Society: Results of the First International Adult Literacy Survey*, 1995.

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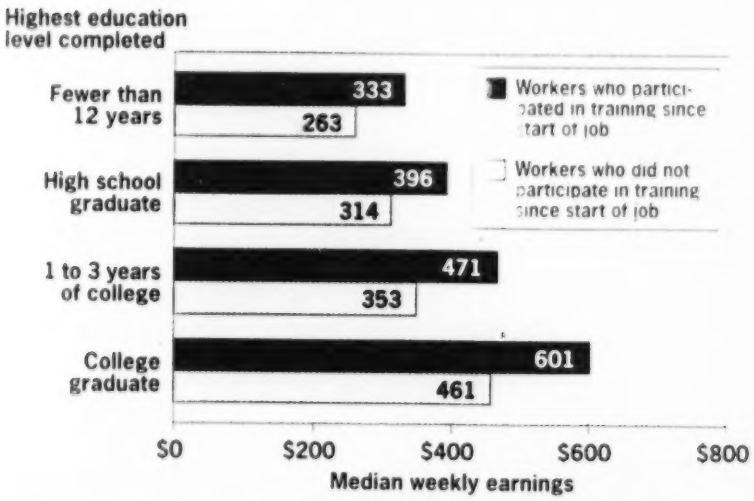
scored at the lowest literacy level on each of the three literacy scales, while the other countries (except Poland) had less than 20 percent of the sampled population scoring at the lowest level on each scale.

Training of Labor Force Participants

Workers usually complete their formal education before joining the labor force, but investment in human capital does not necessarily end at that time. Through training, many workers continue to improve their skills throughout their lives.

- ***Workers who have participated in training while at their current job earn more than workers who have not participated in training.***

Figure 0
Median weekly earnings of full-time workers ages 16 years and older, by training status and educational attainment: January 1991



NOTE: Includes only workers who needed no qualifying training for their current job.

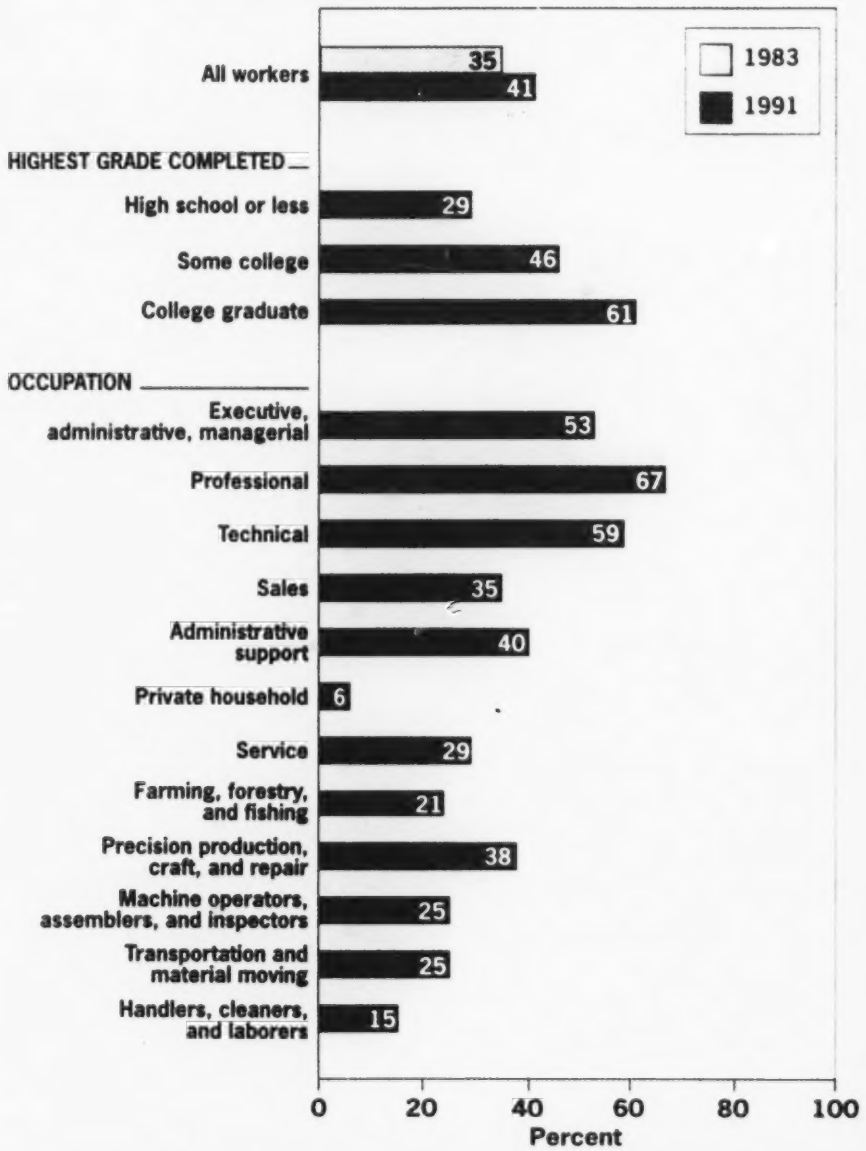
SOURCE: Alan Eck, "Job-Related Education and Training: Their Impact on Earnings," *Monthly Labor Review* (October 1993): 21–38; U.S. Department of Commerce, Bureau of the Census, Current Population Survey, January 1991.

Within broad categories of educational attainment, median earnings in 1991 were higher for workers who participated in training to improve their skills while at their current job than for those workers who did not (figure O). Median weekly earnings were higher for trainees than for nontrainees in each of the educational attainment categories. Studies that examine direct measures of productivity confirm that formal training also has a positive effect on productivity.

- ***Training participation has increased in recent years, and it is most prevalent among more highly educated workers and workers in highly skilled occupations.***

An estimated 41 percent of the U.S. work force in 1991 had received skill improvement training on their current job, up from 35 percent in 1983 (figure P). Training is positively associated with education—61 percent of workers with a college degree in 1991 had participated in training on their current job, compared with 29 percent of workers with a high school degree or less and 46 percent of workers with some college. Training also appears to be more common among workers in highly skilled occupations, including managerial, professional, and technical workers. Workers in these occupations in 1991 had training rates of more than 50 percent. In contrast, no other occupation had a training rate of more than 40 percent at that time.

Figure P
All workers ages 16 years and older who participated in skill improvement training while on their current jobs, by education and occupation: 1983 and 1991 (percentage of workers in each category)

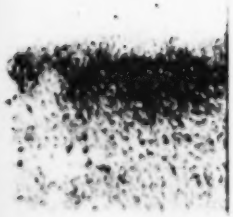


SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, *How Workers Get Their Training: A 1991 Update*, 1992; U.S. Department of Commerce, Bureau of the Census, Current Population Survey, January 1983 and 1991.

SUMMARY

Workers in the United States are still more productive, on average, than workers in any other country. However, worker productivity in several industrialized countries is gradually catching up to that in the United States, and eventually the United States is likely to share the lead in worker productivity. This convergence in productivity is attributable, in part, to the rapid expansion of education in other countries. The education of the work force, according to at least some measures that contribute to economic success, is growing more rapidly in other countries than in the United States. But education is not the only determinant of worker productivity, and other factors no doubt have also played important roles in the rapid productivity growth in other countries.

Although the United States leads almost every other industrialized country in college attainment, and the academic achievement of U.S. students has been improving in recent years, U.S. students still tend to lag behind students in other countries with respect to some measures of achievement. In particular, the mathematics and science scores of U.S. students, especially older students, are lower than those of their counterparts in other industrialized countries. U.S. students do, however, perform relatively well on reading tests. Adults in the United States may not be as skilled in some areas as their counterparts in other countries. Compared to other countries that have tested literacy, the United States has a higher concentration of adults who score at the lowest literacy levels.



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[3]U.S. Department of Labor, Bureau of Labor Statistics, *Labor Composition and U.S. Productivity Growth, 1948–90,* Bulletin 2426 (Washington, D.C.: U.S. Government Printing Office, 1993).

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